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AMCIS 1996 Proceedings

Americas Conference on Information Systems (AMCIS)

8-16-1996

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The design of effective technological support for decision making has at its core a model of the decision making process. Designers of decision support have often looked to the psychological research in judgment and decision making for such models. In the past, human judgment and decision making processes have been characterized as deficient in a number of respects (Kahneman, Slovic, and Tversky, 1982). Over the last three decades, the heuristics-and-biases research alleged that humans, including experienced decision makers trained in appropriate techniques, suffer from myriad biases (e.g., overconfidence, conjunction fallacy, base-rate fallacy) leading to flawed judgments. According to the biases-and-heuristics literature, the biases are "explained" in terms of cognitive heuristics -- notably, anchoring and adjusting, availability, and representativeness. This view of the human decision maker as a poor intuitive statistician has prevailed relatively unchallenged for nearly thirty years.

Recently, the original research and the hundreds of studies it stimulated have come under considerable criticism (e.g., Gigerenzer, 1991a, 1991b; Koehler, forthcoming). In general the criticisms have revolved around two points: 1) the standard for assessing cognitive biases has been too narrowly defined, ignoring "conceptual and technical distinctions fundamental to probability and statistics" (Gigerenzer, 1991b, pp. 88) and (2) the researchers have failed to specify precise and falsifiable process models, identify the conditions under which heuristics are elicited, and articulate the relationship/distinction among heuristics (summarized by Gigerenzer, forthcoming as noted by Einhorn and Hogarth, 1981; Shanteau, 1989; Wallsten, 1983).

Understanding deficiencies in both human information processing and the research surrounding human information processing is critical if we are to design technology-based support of decision making. The following describes several studies that we have executed in which we reexamine the so-called base-rate fallacy within a more general framework of the earlier literature of conservatism (Melone and McGuire, forthcoming; McGuire and Melone, 1992). Implications for the design of decision support systems are offered.

In lay terms, the base-rate fallacy is the result of people under-utilizing historical information and over-emphasizing information about the specific case at hand. An apparent example is initial public offerings (IPOs). The historical rate of return on IPOs is 5%, which is below the historic evidence. Another apparent example close to the hearts of IS professionals is the cost and time required to develop software. The generally accepted explanation for this cognitive bias is the so-called "representativeness heuristic": people base their judgments on the degree to which the object, or person, sounds like it belongs to, or is representative of, a particular category.

To identify a phenomenon as "base-rate fallacy" would seem to imply that the base rate is treated differently from other information. Although the conservatism literature (Edwards, 1968; Phillips and Edwards, 1996) suggests that individuals underweight the case information, curiously no study has estimated the extent to which individuals underweight the case information. One difficulty is that in studies

using experimental tasks containing non-numeric, verbal individuating/case specific information, there is no measure of the information content of the individuating information.

Seeking to address this problem (among others), we designed a new analytic methodology motivated by the realization that the information about base rates provided to subjects in most neglect-of-base-rate studies is just that: information. It must be assimilated and processed by subjects in a way that is similar to any other information to be used, and it is subject to the same hazards in the information assimilation process as any other information. The analytic methodology made possible by our design allows estimation of the absolute weights that subjects place on both the individuating information and the base rate when forming their final probability judgments.

Our methodological work had three other objectives. First the model allows a decision maker to have prior beliefs different from those given by the experimenter, which in earlier research could have influenced the decision maker's probability judgment in a way that would appear to be an underweighting of the base rate. Second, to the extent that Bayes' theorem is the "prescriptive norm," we argue that models expressed in terms of log-odds rather than linear probability models are the preferred specification. Third, we investigate whether decision makers weight information differently as a function of the consistency or inconsistency of the verbal individuating information with the base rate.

In our first study we found that when cues are consistent (base rates and individuating information both point in the same direction): (1) decision makers do not properly calculate the likelihood ratio of the data; and (2) they put more weight on the base rate than on the individuating cue. When cues are inconsistent (base rate and individuating information point in opposite directions), as in the classic problems used in the standard heuristics-and-biases research studies: (1) decision makers again do not properly calculate the likelihood ratio of the data; and (2) they weight the base rate and the individuating information roughly equally, although less than the Bayesian norm of 1.0. This result is consistent with Lynch and Ofir (1989).

We conducted a second set of experiments involving base rates on four socially-relevant issues: abortion, business ethics, capital punishment, and organ donation. The base rates on 25 questions in these areas, which were taken from major national surveys conducted by reputable polling organizations, span a broad range. In our experiments, the average weight on these ecologically valid base rates is .76. In contrast, the average weight on the individuating information is only .33. Again, contrary to the base-rate fallacy, base rates are weighted more heavily than individuating information.

This general underweighting of all information--both the base rate and individuating information--is consistent with the earlier literature on conservatism, which is the term used by Edwards to describe the underweighting of what corresponds to the individuating information. That the classic base-rate fallacy literature contains virtually no references to the conservatism literature is therefore both curious and unfortunate. Edwards' studies did not vary the base rate. By varying both the base rate and the individuating information, our experimental design permits the testing of both conservatism and the base-rate fallacy simultaneously. The results suggest that the underlying phenomenon is general under weighting of *all* probability information, not a specific underweighting of one or another type probability information. Since the distinction between prior and posterior probabilities is spurious anyway (every posterior is prior to some new information), the finding that all information is neglected to about the same extent is reassuring.

In the broader context, our research, like that of Gigerenzer, Koehler and others, questions whether humans are as poor at information processing as implied by the vast literature on "heuristics and biases," including the so-called base-rate fallacy. What we suspect is that people may have learned over time that discounting information is a useful and appropriate mechanism when facing a world of uncertainty and ambiguity. Given these results, designing decision systems and organizations that are robust to more ambiguous information is likely to become increasingly important in the future. Clearly, designing systems that would draw greater attention to the allegedly underweighted base rate could be downright fatal!

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